NRD Assessment of Coastal Areas
Pre-Assessment Screen: 43 CFR Part 11.

ALLEN HARBOR LANDFILL: SITE 09

I. INTRODUCTION, AUTHORITIES, AND DELEGATION.

This determination concerns claims for damages to natural resources of the Allen Harbor Landfill, and adjacent marine habitat area, as authorized by the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended, (CERCLA), 42 U.S.C. s. 9601, et seq., the Oil Pollution Act of 1990, 33 U.S.C. s. 2701, et seq., the Clean Water Act, 33 U.S.C. s. 1251, et seq., and Title 42, Chapter 17.1-1, et seq., of the Rhode Island General Laws. This determination recognizes that there is a claim for damages to natural resources within the trusteeship of the Department of Environmental Management, (RIDEM) and Town of North Kingstown, of the State of Rhode Island.

This determination was prepared by the RIDEM, of the State of Rhode Island, as a trustee of natural resources under the authority of R.I.G.L. s. 42-17.1-2(a), under the authority of Section 107(f) of CERCLA, as amended, 42 U.S.C. s. 9607(f), the National Contingency Plan, 40 C.F.R. part 300, and the DOI Natural Resource Damage Assessment Regulations, 43 C.F.R part 11.

II. INFORMATION ON THE SITE: (INJURY DETERMINATION)

A. Information on the site and on the discharge, release or contamination:

The Allen Harbor Landfill Site 09 location is a fifteen (15) acre grassy wooded area formerly used by the Navy as a landfill for the NCBC Davisville facility. The area of Site 09, is located within a 100-year floodplain and is bounded to the east by Allen Harbor, to the west by Sanford Road, and to the north and south by vegetated wetlands. Allen Harbor is used for recreational boating, and contains two (2) commercial marinas. The history of deposits of contamination is closely intertwined with the history of the use of the NCBC Davisville naval base.

The history of NCBC Davisville is related to the history of Quonset Point, which was the location of the first annual encampment of the Rhode Island Militia in 1893. During World War I, it was a campground for the mobilization and training of troops, and later home to the Rhode Island National Guard.

In 1939, Quonset Pont was acquired by the Navy to establish a Naval Air Station (NAS), with construction beginning in 1940. By 1942, the operations at "NAS Quonset Point" had expanded into what is now known as NCBC Davisville. Land at Davisville adjacent to the NAS, was designated as the "Advanced Base Depot".

While NAS Quonset Point remained a site of Naval activity, Davisville was inactive between World War II, and the Korean conflict. In 1951 it became the headquarters for the Construction Battalion Center, which loaded ships and trained "CBs" for both the Korean and Vietnam conflicts. In 1974, operations at Davisville were greatly reduced. In 1991 the closure of the NCBC Davisville was announced, and it was decommissioned in 1994. The base was officially closed on April 1, 1994.

1. The time, quantity, duration and frequency of the releases and discharges:

From 1946 to 1972, the Allen Harbor Landfill was used for the disposal of waste material generated by the NCBC Davisville facility, and the NAS Quonset Point. Reportedly, a variety of municipal waste, construction-demolition debris, rubble, preservatives, paint thinners, degreasers, (e.g. solvents), PCB oil, asbestos, ash, sewage sludge, and waste fuel oil were disposed into the landfill. The Navy also carried out the burning of various wastes, and covered the site with soils. Since the existing cover is discontinuous, assorted building debris and metallic objects are visible at various locations across the site, including the shoreline and harbor-side face of the landfill.

2. The names of the hazardous substances as found:

Hazardous substances found in the landfill soils, in the adjacent marine sediments, surface waters, and shellfish samples, include halogenated and non-halogenated volatile organic compounds (VOC), polychlorinated biphenyls (PCBs), and heavy metals. In the soil samples of the landfill cover, the most prevalent detected organic constituents were polycyclic aromatic hydrocarbons (PAH). The heavy metals include arsenic, beryllium, chromium, copper, lead, and zinc. VOC, pesticides, and PCBs were detected in the subsurface soils. VOC and PAH were detected in the groundwater collected from three shallow, and one deep, monitoring wells, and from the shoreline sediments. Metal analytes were also detected in the groundwater.

3. The history of current and past use of the site identified as the source of the discharge of contaminants and release of hazardous substances:

The Navy conducted three phases of remedial investigation (RI) at the Site in 1989, 1993, and 1995, respectively. The detection of constituents of concern (COC), in the landfill, soils, sediments, and marine shellfish, as indicated above, resulted from these successive phases of RI.

Shallow groundwater from Site 09 generally flows toward and into Allen Harbor. Deep groundwater appears to flow to the southeast below the landfill wastes, and generally below the Allen Harbor. There is a potential for deep groundwater to

discharge or surface within the harbor. However, based upon infrared photo-graphic analysis by the Navy and U.R.I. in 1995, there does not appear to be a significant amount of groundwater discharging into the harbor from beneath the Site. The Navy believes that the elevated concentrations of COC in the shoreline sediments immediately adjacent to the Site were primarily the consequence of erosions of the landfill face, and overland water runoff. This conclusion is supported by the presence of landfill debris along the shoreline.

Since 1984, the Department has closed the Allen Harbor to all shell fishing as a result of "suspected" contamination by several sources, including the landfill. This closure continues to date, and has effectively barred the ingestion of contaminants through the consumption of shellfish from the tidal beds of the shoreline.

4. Additional contaminants or hazardous substances potentially discharged or released from the site:

Contamination of trusteeship resources may occur from COC in the landfill soils which have been tested at the surface, and subsurface to a depth of ten (10) feet. The COC from the list of detected analytes in the total soils include the inorganic compounds of antimony, arsenic, beryllium, cadmium, copper, manganese, and mercury. The COC from the list of detected semi-volatiles in significant amounts in the total soils include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluorathene[4], benzo(b)fluorathene[3], benzo(k)fluorathene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

The detected analytes in the marine sediments include the inorganic compounds of arsenic, beryllium, lead, and manganese. The detected semi-volatiles in the marine sediments include benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluorathene, and dibenzo(a,h)anthracene.

All of these constituents pose a hazard to trusteeship resources, and the damage of those resources for the foreseeable future.

5. Responsible Parties

The United States Navy is the responsible party and has initiated remedial action in response to the environmental impacts which have resulted as a consequence of the disposal of the municipal and construction demolition waste materials at Site 09.

In November 1989, the entire NCBC Davisville site had been placed on the EPA's National Priorities List (NPL).

In November 1992, the Navy, EPA, and RIDEM entered into a Federal Facility Agreement (FFA) for the remediation for the Installation Restoration (IR) Program sites pursuant to CERCLA. In 1996, the Navy selected a remedy for the containment of Site 09 pursuant to the Department of Defense (IR) Program, which parallels the "Superfund" program conducted by the EPA. The selected remedy for the Allen Harbor Landfill was a multimedia cap, as presented in the Feasibility Study as "Alternative 3", and as a Proposed Plan, (EA 1997).

The ecological risk assessment conducted for the Site in 1996 also included a Marine Ecological Risk Assessment Report and a Freshwater/Terrestrial Ecological Risk Assessment Report, referred to as the "Marine ERA" and the "Freshwater/Terrestrial ERA", respectively. The exposure assessment revealed that the marine organisms that live in and around the sediment in the habitat nearest to Site 09, to the north and south, may be at moderate risk of contamination. The Freshwater/Terrestrial ERA disclosed that maximum concentrations of five (5) of the analyte COC were found in "turbid" water samples taken from the Site. These also pose a threat to the watershed environment.

B. Damages excluded from liability under CERCLA and the Rhode Island Hazardous Waste Management Act:

1. Title 43 C.F.R. 11.24(b) notes damages excluded from liability under CERCLA, and requires the authorized official to determine whether:

a. the damages resulting from the discharge or release were identified in an environmental impact statement or environmental assessment as an irreversible commitment of natural resources, but the release or discharge was permitted, and the facility was otherwise operating within the law; or

b. the damages and the release of a hazardous substance which caused the damage occurred wholly before the enactment of CERCLA; or

c. the damages resulted from the application of a registered pesticide under the Federal Insecticide, Fungicide and Rodenticide Act, 7 U.S.C. 135-135k; or

d. the damages resulted from any other federally permitted release as defined in Section 101(10) of CERCLA.

2. The hazardous waste management regulations derived from R.I.G.L. s.23-19.1-6, s. 23-19.1-7, and s. 23-19.9-10, address the generation, transportation, treatment, storage and disposal of hazardous materials, and the operation of "hazmat" facilities. There is no comparable provision excluding damages,

(more particularly, the occurrence of continuing contamination), resulting from the discharge or release of materials, that pre-dates the 1978 effective date of the statute. Moreover, there has been no presentation of any claim on behalf of a Trustee, regarding any of the affected resources, land area, or circumstances surrounding this injury, to date.

III. PRELIMINARY IDENTIFICATION OF RESOURCES ACTUALLY AT RISK: (DAMAGE DETERMINATION)

A. Potentially Affected resources:

The groundwater and marine sediments which act as habitat for shellfish and other marine species, are the primary resources which have been contaminated by the COC present from the Allen Harbor Landfill. This contamination presents human health risks from actual and potential contact with the groundwater, and ingestion of the shellfish from the sediment beds. This results in placement of severe restrictions on human contact with these resources for the foreseeable future.

B. Exposed areas:

The area contaminated with the COC includes the surface soils, subsurface soils, groundwater beneath the site, both at shallow, and deep bedrock levels, the marine sediments, the shellfish adjacent to the landfill areas within these sediments, and the surface waters of the wetlands on Site 09.

C. Preliminary Identification of pathways:

The surface waters and groundwater pathways are suspected as the primary conduits of the manifestation of the COC damaging the trusteeship natural resources. The marine sediments and shoreline erosion of the face of the landfill deposits are the pathways to degradation of the marine habitat and shellfish beds.

Potential human cancer risks which may be associated with the site related COC would be of concern for future residents of the Town, and recreational users. The exposure scenario for future residents is consumption of Site 09 groundwater as a drinking source. The exposure scenarios for future recreational users include skin contact and inhalation of the VOC from site groundwater while showering, consumption of shellfish from the landfill shoreline, and incidental ingestion of surface dust and soils. Other pathways may be further identified during the formal and more thorough damage assessment.

It should be noted however, that the exposure scenarios are unlikely as the preferred use of the area in the “Base Reuse Plan” recommends that Site 09 be designated as open space or conservation land. Additionally, the current ban on

shellfish from the Allen Harbor obviates the requirement of a further ban on marine product from the landfill shoreline.

D. Estimates of concentrations:

The contaminant concentrations at the Allen Harbor Landfill were measured and calculated in relationship to the potential human health risks associated with exposure in the Record of Decision, (ROD) completed in September, 1997. Those designated as "constituents of concern" when determined from soil and well samples on the Site, or sediment samples from the harbor, were weighed in relation to "risk based concentrations" that would be harmful to human contact. In all cases, where a maximum chemical concentration was found in excess of the risk base, it was listed as a COC. The following table was taken from the appendices of the ROD. It sets forth the concentrations by percentage, of each constituent where possible, found to exceed the acceptable level of human risk:

Inorganic Constituents	**Percentage Above Risk Level**	**Location**
Aluminum	51%	Groundwater
Antimony	98%	" "
	9%	Total soils
Arsenic	88%	" "
	99%	Groundwater
	90%	Sediments
	99%	Shellfish
Beryllium	41%	Sediments
	99%	Groundwater
Cadmium	42%	Total soils
	100%	Shellfish
Chromium	68%	Groundwater
	70%	Shellfish
Copper	69%	Total soils
	100%	Shellfish
Lead	100%	Total soils
	100%	Sediments
	100%	Groundwater
	100%	Shellfish
Manganese	66%	Total soils
	14%	Sediments
	100%	Groundwater
	96%	Shellfish
Mercury	83%	Shellfish
Thallium	92%	Groundwater
Zinc	100%	Shellfish

Semi-volatile Constituents;	**Percentage Above Risk Level;**	**Location;**
Benzo(a)anthracene	98%	Total soils
	8%	Sediments
	100%	Shellfish
Benzo(a)pyrene	99%	Total soils
	82%	Sediments
		Shellfish
Benzofluroathene[(4)]	92%	Shellfish
Benzo(b)fluoranthene	98%	Total soils
	9%	Sediments
Benzo(k)fluoranthene	84%	Total soils
Benzotriazole	100%	Shellfish
Bis(2-chloroethyl)ether	100%	Groundwater
Bis(2-chloroisopropyl)ether		Groundwater
Chlorinated Benzotriazole		Shellfish
Dibenzo(a,h)anthracene	97%	Total soils
	22%	Sediments
		Shellfish
Dibenzofuran	63%	Groundwater
Indeno(1,2,3-cd)pyrene	90%	Total soils
	57%	Shellfish
Methylphenol	52%	Groundwater

Volatile Constituents	**Percentage Above Risk Level**	**Location**
Acetone	7%	Groundwater
Benzene	98%	Groundwater
2-Butanone	96%	Groundwater
Chlorobenzene	99%	" "
1,4-Dichlorobenzene	99%	" "
1,2-Dichloroethane	99%	" "
1,2-Dichloroethene	99%	" "
1,2-Dichloropropane	99%	" "
Methylene Chloride	87%	" "
Tetrachloroethene	99%	" "
1,1,2-Trichloroethane	81%	" "
Trichlorethene	98%	" "
Vinyl chloride	99%	" "

Pesticides	Percentage Above Risk Level	Location
Aldrin	100%	Shellfish
4,4'-DDE	28%	Shellfish
Aroctor-1242[3]	95%	Groundwater
Aroctor-1242[6]		Shellfish
Aroctor-1254[3]	10%	Groundwater
Aroctor-1254[6]		Shellfish
Aroctor-1260[3]	94%	Groundwater
Aroctor-1260[6]		Shellfish.

IV. PREASSESSMENT SCREEN CRITERIA.

The outline of Title 43 CFR Part 11:23(e) criteria that are met as a pre-condition of NRD assessment and claim. The criteria are as follows:

1. A discharge of oil or a release of a hazardous substance has occurred;
2. Natural resources for which a State or Federal agency or Indian tribe may assert trusteeship under CERCLA have been, or are likely to have been, adversely affected by the discharge or release;
3. The quantity and concentrations of the discharged oil or release of hazardous substance is sufficient to potentially cause injury, as that term is used in this part, to those resources;
4. Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost;
5. Responsible actions, if any, carried out or planned, do not or will not sufficiently remedy the injury to natural resources without further action;

These criteria are satisfied for the releases of hazardous substances covered by this pre-assessment screen as follows:

Criteria #1: Discharges of contaminants and releases of hazardous have occurred;

There have been several discharged constituents of concern (COC) in the Allen Harbor Landfill. From 1946 through 1972 the Landfill was used for the disposal of waste material generated by the NCBC Davisville, and NAS Quonset Point. A

variety of wastes including municipal type, construction debris, rubble, preservatives, paint thinners, degreasers, PCB oils, asbestos, ash, sewage sludge, and waste fuel oil, were disposed of in the landfill. The disposal process during those years included open burning of wastes, followed by a cover of soil. The majority of the COC exist in proportions greater than the Risk Base for human exposure. The concentrations of contaminants are listed as hazardous substances in Federal Regulations at 40 CFR 302.4, pursuant to Section 102(a) of CERCLA and Section 311 of the FWPCA.

The surface and sub-surface soils, the groundwater, and the shellfish and shellfish beds adjacent to the landfill, have been found to be contaminated by these COC to varying degrees.

Criteria #2: Natural resources for which the RIDEM may assert trusteeship under CERCLA (HAZARDOUS WASTE MANAGEMENT ACT; R.I.G.L. 23-19.1-22(c)) have been or are likely to have been adversely affected by the release or contamination;

The State of Rhode Island, through the Department of Environmental Management, has jurisdiction and trusteeship over the natural resources of the state including waters, soils, and air. **R.I.G.L. 42-17.1-2(a).** This provision also grants jurisdiction and trusteeship over adjacent areas in the harbor, and affected species such as fish shellfish and other aquatic life.

Criteria #3: The quantity and concentration of the released hazardous substance is sufficient to actually (potentially) cause injury to those natural resources;

A natural resource injury is a measurable adverse change in the chemical, or physical quality or the viability of that resource resulting either directly or indirectly from exposure to a discharge of a hazardous substance, or a release of oil, or exposure to a chemical reaction resulting from such a discharge or release.

An injury to the ground water, sediments and shellfish beds, all of which are natural resources under State jurisdiction, has resulted from the release of hazardous substances, if certain changes in the physical and chemical quality of the resource is documented. These changes, defined in 43 C.F.R. Part 11.62(c), include concentrations of substances sufficient to have caused injury to biological resources when exposed to, or infused with, the substances. The evidence that such resources have been contaminated is set forth in the appendices of the ROD, completed in 1997. The investigative studies of 1991, 1994, and 1996, confirmed the presence of both halogenated and non-halogenated volatile organic compounds (VOC), polychlorinated biphenyls (PCBs), and metals.

The volatiles and semi-volatiles are found in excessive amounts in the deep and shallow groundwater, the shoreline sediments, the shellfish and shellfish beds off-shore adjacent to the landfill.

A risk on Site 09 is human exposure to contaminants through various pathways. Ingestion of the groundwater, dermal contact with the groundwater during ordinary use, (such as showering at a potential recreational facility), inhalation of volatiles from the soils, incidental ingestion of shoreline sediments by recreational users, and consumption of shellfish from the area, are the probable pathways of exposure, and enhanced risk to the residents.

Ecological risks to marine organisms in the Allen Harbor, (non-consumed), are reported to be "moderate" to "slight", while risks to terrestrial ecological receptors were reported to be moderate to "high", within the watershed.

Criteria #4: Data sufficient to pursue an assessment are readily available or likely to be obtained at reasonable cost;

A human health risk assessment (HHRA) was conducted on Site 09 in 1995 on the basis of the phase test results. The HHRA estimated the probability and magnitude of potential adverse human health effects associated with exposure to the constituents detected in the surface soil, subsurface soil, ground water, surface water, inter-tidal sediment, shellfish and soil gas. The HHRA followed the four step process in accordance with the EPA guidelines: (1) identification of the hazardous substances; (2) exposure assessment, including the pathways, populations, nature, and magnitude; (3) toxicity assessment, including the type and magnitude of adverse health effects; and, (4) risk characterization, including potential and actual site specific carcinogenic and non-carcinogenic risks.

Potential human health risks associated with exposure to the constituents were estimated through the development of several hypothetical exposure scenarios. These scenarios were developed to reflect the potential for exposure based upon present use, potential future uses, and the location of the contamination. Risk estimates were evaluated using EPA's established target risk range for Superfund cleanups. A conservative approach was taken where risks from all exposure pathways and all COC were summed to yield the total carcinogenic and non-carcinogenic site risk for a given receptor. Calculated cancer risks which were higher that EPA's upper bound acceptable risk level were associated with the developed exposure scenarios. These scenarios were considered to represent potentially completed pathways of exposure to COC in onsite media (soil, groundwater, air) and offsite media (sediment, surface water) and included: (1) exposure of construction workers during future remediation of the site; (2) exposure of future onsite recreational users of the site and areas of Allen Harbor near the site; (3) future ingestion of shellfish from the shoreline by local residents; and, (4) hypothetical future residential use of site groundwater. The activities associated with the scenarios include daily and otherwise innocuous inhalation of

VOC and dermal contact during showering, consumption of shellfish, and consumption of groundwater by these remedial, residential, and recreational users.

Calculated risks which fell within the target cancer risk range for Superfund cleanups established by EPA were associated with incidental ingestion of soils, by remedial and recreational users, dermal contact with the surface soils, and incidental ingestion of sediments by recreational water users.

In short, potential cancer risks which may be posed by site related COC will be of concern to future remedial workers, residents, and recreational users that come into daily and otherwise innocuous contact with soils, groundwater, shoreline sediments, and shellfish from the adjacent beds.

Criteria #5: Response actions, if any, that have been planned or carried out will not or do not sufficiently remedy the injury to natural resources without further action;

Remedial alternatives were developed and subjected to a detailed analysis in the "Feasibility Study Report for Site 09 – Allen Harbor Landfill" of 1996, also referenced in the ROD. The remedial alternatives consisted of "No Action", as required by the NCP in order to provide a baseline comparison, a Soil Cap, a Multimedia Cap, and a Multimedia Cap with Vertical Barriers. Each of the remedial alternatives, with the exception of the No Action alternative, includes several distinct remedial components.

1. The **No Action** alternative is required pursuant to Section 00.430(e)(3)(ii)(6) of the revised NCP, as a baseline for comparison with other remedial alternatives. Under this alternative, no remedial action or institutional control would be implemented or maintained at the site, other than a long term monitoring program and review every five (5) years. The existing landfill would remain in place, with no provisions for re-grading or active maintenance. Pursuant to CERCLA Section 121 (c), 5-year reviews would be conducted because the COC would remain on site at concentrations above health-based levels. The projected or estimated costs associated with this alternative are set forth as follows:

1. Estimated Annual Operation and Maintenance Costs For Monitoring : $74,000.

2. Estimated Total 30 Year Costs: $1,200,000.

2. The **Soil Cap** alternative consists of construction of an engineered, multi-layered soil cap on the landfill to contain the source area constituents. This alternative would prevent human and terrestrial animal contact with the fill and COC materials, control surface water runoff, and erosion, reduce infiltration, and maintain a natural habitat for local and migratory wildlife. This is projected to be constructed with a bedding layer, and a vegetative support layer as a covering.

Water removal would be accomplished by surface soil infiltration and deep-rooted native plant species. This project is often times referenced as an "evapotranspiration" cover.

As referenced in the ROD, the Navy has agreed to obtain the materials for the creation and restoration of the wetlands by dredging the Allen Harbor entrance channel, as was requested by the Town of North Kingstown.

An operation and maintenance program would ensure the long-term integrity and effectiveness of the Soil Cap. The projected and estimated costs of this alternative are set forth as follows:

1.	Estimated Time for Design and Construction:	24 months.
2.	Estimated Capital Cost:	$6,400.000.
3.	Estimated Annual Operation and Maintenance:	$ 102,000.
4.	Estimated Total 30 year Costs:	$8,000,000.

3. The **Multimedia Cap** alternative containment of the source area constituents is accomplished by construction of a Multimedia Cap over the landfill. This will reduce water infiltration and thereby reduce the potential of the COC to leach from the landfill into the groundwater. This will also control surface water runoff, erosion, and prevent human and terrestrial animal contact with the soils and fill materials.

The Cap will be made up of several layers which include a 12 inch bedding layer, a landfill gas vent layer, a compacted clay liner or a geo-composite clay liner, a geo-membrane liner or a flexible membrane liner, a 12 inch drainage layer, an 18 inch barrier protection layer, and a 6 inch vegetative support layer constructed above the projected 100 year storm level.

The impermeable liners for the Multimedia Cap would be terminated at the storm surge high water level to avoid compromise of the long-term effectiveness owing to hydrostatic pressure from a flooded liner. The remedy will employ the sediments dredged from the entrance to the Allen Harbor as a pre-cap grading or bedding material and construction of the shoreline wetlands, as feasible. The actual configuration of the containment system will be established in the design analysis for the remedial action. The Multimedia Cap will be vegetated and a program will be set to ensure that the plan roots do not degrade the barrier materials.

An operation and maintenance program would be needed to maintain the long-term integrity and effectiveness. The projected and estimated costs of this alternative are set forth as follows:

1.	Estimated time for design and construction:	26 months.
2.	Estimated Capital Cost:	$ 8,000,000.
3.	Estimated Annual Operation and Maintenance Costs:	$ 113,000.
4.	Estimated Total 30 Year Costs:	$10,300.000.

This alternative has been determined to be the preferred and selected remedy for Site 09, Allen Harbor Landfill.

4. The **Multimedia Cap with Vertical Barriers** alternative includes all of the features of the Multimedia Cap alternative with the addition of vertical walls surrounding the site. These walls would consist of "bentonite" slurry walls and steel sheet pilings. The slurry wall would be installed along Sanford Road, and keyed into the bedrock layer beneath the site to mitigate up-gradient groundwater from flowing through the source area. Sheet piling would be installed along the site shoreline and keyed into the silt layer to cut off shallow groundwater flow while allowing the hydraulic head on either side of the barrier wall to stabilize.

An operation and maintenance program would be needed to maintain the long-term integrity and effectiveness of this alternative. The projected estimated costs of this alternative are set forth as follows:

1.	Estimated time for design and construction:	30 months.
2.	Estimated Capital Cost:	$12,600,000.
3.	Estimated Annual Operation and Maintenance Costs:	$ 117,000.
4.	Estimated Total 30 Year Costs:	$14,400,000.

To date, the selected remedy has not been undertaken. When completed, it will not remediate the site, nor bring it to a standard that the identified natural resources can be considered to be free from damage.

V. PREASSESSMENT SCREEN DETERMINATION OF NATURAL RESOURCE DAMAGES .

Part I --- Groundwater Damage Assessment

The first proposed method used to quantify the damages to the natural resources at the Allen Harbor Landfill were calculated to assess the damage done to the aquifer as a result of contamination emanating from Site 09. The groundwater analysis is based on the fact that the groundwater beneath the site is presently and foreseeably unavailable for human consumption, use, or inhalation through showering. The Site is approximately fifteen (15) acres in size. Groundwater recharge was applied at a rate of 25.0in/year. This was the annual recharge rate estimated for the neighboring Hunt Aquifer System which has the same stratified drift deposits above the water table, as Allen Harbor.

The method used to determine the affected groundwater resources of the Site was to quantify the volume of recharge available to the impacted groundwater, which was considered to be above Maximum Contaminant Levels (MCL) in the shallow and deep aquifer.

The Site is located in the Main Center of the U. S. Naval Construction Battalion Center, (NCBC) Davisville, in North Kingstown, Rhode Island. It is an approximate fifteen (15) acre grassy area formerly used by the Navy as a landfill.

Assumptions:

The value of the lost potable water was calculated using the water rates of the Town of North Kingstown and its water department that are currently charged. The value of the lost potable water was calculated over a standard thirty (30) year Planning horizon. An effective annual interest rate of seven percent (7%) was used in the calculations to facilitate the economic computations. The percentage is based upon the conservative effective interest rates commonly used both in commerce, and by the State of Rhode Island, in past claims.

The Town of North Kingstown water rates are set forth for the years indicated with an average increase of five and three tenths percent (5.3%) per year:

1997 = $1.528/1000 gallons,
1998 = $1.592/1000 gallons,
1999 = $1.714/1000 gallons,
2000 = $1.863/1000 gallons,
2001 = $1.898/1000 gallons,
2002 = $1.953/1000 gallons.

Calculations:

The Town of North Kingstown's water rates are:

1. Current municipal charge for NK water is $1.953 per 1000 gallons;

Area of concern 15 Acres:

- (43,560 ft^2/acre) (15 acres) = 653,400 ft^2

In order to determine the volume of contaminated water within this area a groundwater recharge rate of 25.0 in/year was applied to the Site. This was the annual average recharge rate estimated for the neighboring Hunt Aquifer System that has the same stratified drift deposits above the water table as Allen Harbor Landfill. Therefore:

- (653,400 ft^2) * (25 inches/ year) * (ft/12 inches) ≈ 1,361,250 ft^3/yr

1,361,250 ft^3 * 7.48 gallons/ ft^3 ≈ 10,182,150 gallons of potential drinking water per year.

Engineering Economic Calculations:

The calculation on economic value projected out for thirty (30) years was taken from the Principles of Engineering Economic Analysis, J. White *etal.,* John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The current value of annual water rate of yearly use equals the total of 10,182,150 gallons per year multiplied by $1.953/1000 gallons equals **$19,886**.

(B) The annual value of water-increased costs due to inflation in the year 2032, at the rate of increase of 5.3% per year equals **$88,912**.

(C) The average yearly increase in water rate over thirty years equals **$2,380**.

(D) The present value of thirty-year supply of water is calculated according to the following formula:

P2002 ≈ A (P/A 7%, 30) + G (P/G, 7% 30)

P2002 ≈ $19,886 (12.4090) + $2,380 (120.9718)

P2002 ≈ $246,765 + $287,913 ≈ $534,678

Total Present Worth of Groundwater-Related Natural Resource Damages:

P2002 ≈ $534,678.

Part II – Shellfish Closure Damage Assessment

In 1984 the Rhode Island Department of Environmental Management filed with the Secretary of State what was in effect an emergency regulation closing Allen Harbor to shell fishing. This action was prompted by concerns of chemical contamination of the beds as a result of releases from the former Navy landfill known as Allen Harbor Landfill. Since this action was taken the beds have remained closed. Currently, there are no plans to reopen the beds.

The following calculations attempt to access the monetary value of the loss of the shellfish resource. The shellfish resource analysis is based on the fact that the shellfish grounds in Allen Harbor are no longer available as a resource. The calculations are based upon information obtained from a survey of the fisheries resources at Allen Harbor, conducted by the Department of Environmental Management, and studies performed by the United States Navy (Referenced Below).

Monetary Assessment of Shellfish Resource

Information concerning the stock of shellfish, Mercenaria mercenaria (quahogs) and Mya arenaria (soft shell clams), in Allen Harbor was primarily obtained from a study conducted in 1977 by the Rhode Island Department of Environmental Management, Division of Fish & Wildlife Inventory. In this study sixty-four stations in Allen Harbor were quantitatively sampled for Mercenaria mercenaria (quahogs) and Mya arenaria (soft shell clams). In addition to obtaining abundance information the study also examined the length frequency distribution of the bivalves. The length frequency distribution provides information concerning the harvestable yield of the area. Supplementary information was also obtained from an Ecological Risk Assessment conducted by the United States Navy of Allen Harbor in 1995. This study was not as intensive as the study performed by the DEM. Further, shell lengths were not measured in this study.

Information concerning the standing stock of other commercial shellfish, oysters, ribbed mussels, etc was also obtained (1995 study performed by the United States Navy).. This information was qualitative in nature, presence or absence of species was noted in the report. No quantitative information was found for these species in the study area. Officials from the DEM Office of Fish and Wildlife

were queried concerning possible methods to obtain information on standing stocks of these shellfish species. The officials stated that there is no constant ratio for the different species of shellfish in a particular substrate. That is, knowledge concerning the number of quahogs or soft shell clams in an area could not be used to estimate the number of oysters or mussels. Comparison studies to similar harbors may be used. That is the standing stocks of oysters, mussels, etc. in similar harbors could be applied to Allen Harbor. However, these comparisons would be subjected to questions concerning the comparability of the different sites. Accordingly, the economic value of the other shellfish species known to exist in the harbor was not performed at this time.

Methodology and Assumptions

Information from the above reports was used to obtain the average number of bivalves per square meter of the study site. The average number of bivalve per square meter was multiplied by the size of the closed area to obtain an estimate of the standing stock of the resource. The standing stock represents the total number of shellfish in the study area.

The standing stock value was used to calculate the sustainable yield of the resource. That is, the amount of the resource which could be substantially harvested without depleting the stock. The sustainable yield used was twenty percent of the resource. This is a standard value used by the RIDEM, Office of Fish and Wildlife. The value is based upon the life cycle of the bivalves and the time needed to reach harvestable size (five years).

The sustainable yield for Mercenaria mercenaria (quahogs) and Mya arenaria (soft shell clams) was calculated by directly multiplying the standing stock by the standard value (twenty percent). This assumes a natural distribution in shellfish size in the affected area (that is, the standing stock is not primarily composed of undersized shellfish). A review of the information concerning shell length size provided in the DEM study indicates that this is a valid assumption.

In order to obtain the monetary value of the resource in 2002 the sustainable yield for each bivalve population (total number of bivalves which could be safely harvested in one year) was then multiplied by the current (2002) market price of the bivalves. For quahogs, the size of the shellfish also determines its price. Accordingly, the shell length was also factored into the monetary assessment for the quahogs. This required normalization of the quahog shellfish population. Specifically, the sustainable yield is harvested from legal size shellfish population (Little Necks–Chowder). Due to natural population distributions, and the fact that the sub classification of shellfish is based upon a length distribution which is not equal (ex. shellfish length Little Necks 25-34 mm, Top Necks 35-39 mm) the legal sized population was normalized to the sustainable yield (See Calculations and Table Below).

Calculations:

Mercenaria mercenaria (quahogs)

Average number of quahogs per square meter [1]	2.56
Closure Area (square meters)	383,223
Estimated Standing Stock Average Number of quahogs per square meter multiplied by closure area.	981,050
Sustainable yield Estimated standing stock multiplied by 20 %	196,210

Classification Percent- Portion of Standing Stock Represented by Each Class of Quahogs (percent)

Little Necks	26
Top Necks	8.9
Cherry Stones	11.2
Chowder	33.6
Undersize (below legal harvest size)	20.2

Total Number of Sustainable Yield Quahogs in Each Class[2]

Little Necks	64,008
Top Necks	21,910
Cherry Stones	27,573
Chowder	82,718
Total[3]	196,209.

Notes:

1. Inventory of the Fisheries Resource of the Quonset-Davisville Area, North Kingston, Rhode Island, January 1977.
2. Total Number of Sustainable Yield Quahogs in Each Class
   Ex. Little Necks (100/percentage of quahogs that could be harvested) X (percent of quahogs in Little Neck Classification) X (total number of quahogs which can be harvested on a sustainable basis). (1/.797)*.26*196,210 = 64,008
3. Normalized sustainable yield does not equal direct sustainable yield due to assumptions in rounding.

Monetary Value of Quahogs in 2002

Quahog Classification	Little Necks	Top Necks	Cherry Stones	Chowder	Total

Classification Percentage [1]	26	8.9	11.2	33.6	79.7
Total Number of Sustainable Yield Quahogs in Each Class	64,008	21,910	27,573	82,718	196,209
Price Per Quahog (dollars)	0.17	0.14	0.1	0.1	NA
Monetary Value of Individual Classes of Quahogs (dollars)	10,881.36	3,067.40	2,757.30	8,271.80	24,977.86

Notes:

1. Classification Percentage- The portion of the total quahog population represented by a particular subgroup. Portion which is below legal size is not represented in this table.
2. Normalized Classification Percentage- The portion of the total quahog population represented by a particular subgroup modified to reflect sustainable yield of beds.

Mya arenaria (soft shell clams)

Average number of quahogs per square meter 19.75

Closure Area (square meters) 383,223

Estimated Standing Stock
Average Number of clams per square meter multiplied by closure area. 7,568,654

Sustainable yield
Estimated standing stock multiplied by 20 % 1,513,731

Average price per clam $0.11

Monetary Value of Sustainable Yield of Soft Shell Clams in 2002
Price per clam Multiplied by sustainable yield **$166,510.39**

In order to determine the monetary value over the assessment period, the average rate of inflation (average inflation rate from 1980-2000 utilizing the consumer price index) was used in lieu of actual cost data for bivalves. This was done due to the inability to obtain reliable bivalve data, over a sufficient time period in order to make the calculation valid.

The monetary value for the assessment period was calculated by projecting out the cost over a standard thirty year planning horizon (2002 to 2032), and back calculating the cost from 1984 –2002 (period of closure to date).

The assessment period was assumed to end in the year 2032, which is the same value used in the groundwater evaluation. As a result of the remedial action performed at this site is not known if the shell fishing beds can be opened at the end of the thirty-year period. Currently, in part to address this concern, a long term monitoring program has been put in place

Engineering Economic Value Calculations:

Mercenaria mercenaria (quahogs)

The calculation on economic value projected out for thirty (30) years was taken from the Principles of Engineering Economic Analysis, J. White *etal.,* John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The current (2002) value of the sustainable crop of quahogs equals $24,977.86.

(B) The annual value of quahog increased costs due to inflation, based on a common price index, in the year 2032, at the rate of increase of 4.23% per year equals **$ 86, 564.01.**

(C) The average yearly increase in the cost of quahogs over thirty years equals **$2123.66**.

(D) The present value of thirty-year harvest of quahogs is calculated according to the following formula:

$$P2002 \approx A\,(P/A\ 7\%, 30) + G\,(P/G, 7\%\ 30)$$

$$P2002 \approx \$24{,}977.86\ (12.4090) + \$2123.66(120.9718)$$

$$P2002 \approx \$309{,}950.26 + \$256{,}902.97 \approx \mathbf{\$566{,}852.23}$$

The calculation on economic value projected back for seventeen (17) years was

taken from the Principles of Engineering Economic Analysis, J. White *etal.,* John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The 1984 value of the sustainable crop of quahogs equals $11849.12.

(B) The annual value of quahog-increased costs due to inflation in the year 2001, at the rate of increase of 4.23% per year equals **$ 23,964.18**.

(C) The average yearly increase in the cost of quahogs rate over sixteen years equals **$757.19.**

(D) The present value of seventeen-year harvest of quahogs is calculated according to the following formula:

P2001 ≈ A (P/A 7%, 17) + G (P/G, 7% 17)
P2001 ≈ $11,849.12 (9.7602) + $757.19 (62.5923)
P2001 ≈ $115,649.78 + $47,394.34 ≈ **$163,044.12**

The Total Present Worth of Quahog Resource Related Natural Resources Damages

P1984-2001 + P2002-2032
$163,044.12 + $566,853.23 ≈ $729,897.35

Mya arenaria (soft shelled clams)

The calculation on economic value projected out for thirty (30) years was taken from the Principles of Engineering Economic Analysis, J. White *etal.,* John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The current (2002) value of the sustainable crop of soft shell clams equals **166,510.39.**

(B) The annual value of soft shell clams, increased costs due to inflation in the year 2032, at the rate of increase of 4.23% per year equals $577,063.32.

(C) The average yearly increase in the cost of soft shell clams over thirty years equals **$14,157.00**.

(D) The present value of thirty-year harvest of soft shell clams is calculated according to the following formula:

P2002 ≈ A (P/A 7%, 30) + G (P/G, 7% 29)

P2002 ≈ $166,510.39(12.4090) + $14,157.00 (120.9718)

P2002 ≈ $2,066,227.43 + $1,712,597.77 ≈ **$3,778,825.20**

The calculation on economic value projected back for seventeen (17) years was taken from the Principles of Engineering Economic Analysis, J. White *etal.,* John Wiley & Sons, Inc. 1977.

The abbreviations used in the value calculations are as follows:

P = present worth,
F = future worth,
G = uniform gradient,
A = annual worth.

(A) The 1984 value of the sustainable crop of clams equals **$78,989.99**.

(B) The annual value of clams increased costs due to inflation in the year 2001, at the rate of increase of 4.23% per year equals $ 159,752.84.

(C) The average yearly increase in the cost of clams rates over sixteen years equals **$5047.68**.

(D) The present value of seventeen-year harvest of clams is calculated according to the following formula:

P2001 ≈ A (P/A 7%, 17) + G (P/G, 7% 17)

P2001 ≈ $78,989.99 (9.7602) + $5047.68 (62.5923)

P2001 ≈ $770,958.10 + $315,945.90 ≈ **$1,086,904.00**

The Total Present Worth of Soft Shelled Clam Resource Related Natural Resources Damages

P 1984-2001 + P2002-2032
$1,086,904.00 + $3,778,825.20 ≈ $ 4,865,729.20

Part III---Wetlands Loss Damage Assessment

Operational activities at the landfill and activities associated with subsequent remedial actions have changed the topology at the site. During the operation period, the landfill was extended into the harbor by placing waste directly into the waters of the State. The beach profile at the site was also changed as a result of activities at the landfill. Additional alterations resulted during the construction of the RCRA Subtitle C cap and the construction of the engineered wetland along the entire toe of the landfill.

Attached are calculations that attempt to access the monetary value of the loss associated with the placement of waste directly into the waters of the State. The assessment does not address any losses of resources associated with the changes in the beach profile or losses of additional waters of the State associated with the construction of the engineered wetland at the landfill toe.

Methodology

The losses associated with placing waste directly into the waters of the State was calculated by comparing the changes in land area in 1939 and 1997 aerial photographs. The 1939 photograph was selected as it represented conditions at the site prior to the initiation of waste disposal activities. The 1997 photograph was selected as it represented conditions after cessation of waste disposal, as well as, the state of the site prior to the construction of the RCRA Subtitle C cap and the engineered wetlands.

The 1939 and 1997 aerial photographs were digitized in GIS. Landmarks in the 1939 and 1997 computer digitized aerial photographs were match so that the two photographs could be overlaid. The difference in the land areas between the two photographs was calculated using GIS.

The monetary loss associated was calculated by taking the difference in land area and multiplying by the value for restoration. A restoration value of $50,000 dollars per acre was used. This is a value that has been used and accepted in other Natural Resource Damage Claims in Rhode Island.

Calculations

Difference in land area 1939 and 1997 digitized aerial photographs acres. 0.85

Restoration cost $50,000/acre

Total Monetary Value of Loss:

0.85 acres * $ 50,000/acre ≈ $42,500

Summary of Natural Resource Damages

Resource	**Total Present Worth**
Groundwater-Related Natural Resource Damages	$ 534,678.00
Shellfish Beds Related Natural Resources Damages	5,595,626.55
Wetlands Resources Damages	42,500.00
Value of All Claims	**$6,172,804.55**